WAKA KOTAHI
NZ TRANSPORT AGENCY

ACTIVE WARNING AND REGULATORY SIGNS

ITS Delivery Specification

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0.6

New Zealand Government

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More information
If you have further queries, contact the ITS S&S team via email: itsspec@nzta.govt.nz

More information about intelligent transport systems (ITS) is available on the Waka Kotahi website at https://www.nzta.govt.nz/its

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1 DOCUMENT CONTROL

1.1 Document information

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1.2 Document owner

Role Head of Technology Engineering

Organisation Waka Kotahi

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation
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1.4 Version history – major changes

Document version control is the process of tracking and managing different versions (or drafts) of a document to easily identify the current iteration of a file.

This table shows a record of all major (published) versions of this document **(for Waka Kotahi use only)**. To record minor versions (author updates, amendments etc), go to section 11 Full version history.

Version	Date	Author	Role and organisation	Reason
1.0	DD/MM/YYYY			
2.0	DD/MM/YYYY			
3.0	DD/MM/YYYY			

2 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi.
PENDING	The document has been finalised and is pending approval and ratification by Waka Kotahi. It can be used for procurement at this status.
RATIFIED	The document is an official Waka Kotahi document. Road controlling authorities are obliged to follow a document with this status.
RETIRED	The document is obsolete, and/or superseded.
AS/NZS	Australian/New Zealand standard
Aspect	Front face of the sign as observed by road users when activated
AWS	Active Warning Signs - this abbreviation also covers active regulatory signs
CSV	Comma-separated values
Display matrix	Visible part of an electronic sign which contains the pixels that can be activated to display the message.
EN	European standard
Enclosure	Housing for electronics systems to protect against environmental conditions.
FAT	Factory acceptance test
Hz	Hertz
IP	International Protection code (sometimes interpreted as Ingress Protection code) classifies the degree of protection provided by mechanical casings and electrical enclosures against intrusion, dust, accidental contact and water.
IoT device	Internet of Things-based communications device
ISZ	Intersection speed zones
ITS	Intelligent transport systems
km/hr	Kilometres per hour
LED	Light-emitting diode
LR	Luminance ratio
NIWA	National Institute of Water and Atmospheric Research
m	Metres
mm	Millimetres
ms	Milliseconds
OEM	Original equipment manufacturer
Pixel	Smallest controllable element of a display matrix for an electronic sign or signal.
Pixel pitch	Distance between centres of adjacent pixels.
RCA	Road controlling authority

Term	Definition
SAT	Site acceptance test
SID	Speed indicator device
TCD manual	Traffic control devices manual
TOC	Transport operations centre
WAVSL	Weather-activated variable speed limit

3 OVERVIEW AND OUTCOMES

This section defines the purpose of the equipment within the operational system.

3.1 Purpose

The purpose of this delivery specification is to specify the requirements for the procurement of a range of electronic active warning and regulatory signs (AWS) by Waka Kotahi. In addition, this delivery specification details system integration requirements (such as protocols, interfaces, data standards etc) to ensure compliance with Waka Kotahi operational and asset management systems.

Delivery assurance is managed through a series of delivery specifications which support procurement and systems integration. The key risks that specifications address are ensuring the correct equipment is being procured, that it will integrate with operational systems, and will deliver the correct functionality and performance requirements.

3.2 Overview

The outcomes of this delivery specification are to provide the specific requirements in order to procure high quality, energy efficient and long-lasting AWS.

3.2.1 Definition

AWS are intended for use as activated advanced hazard warning devices. The application of an advanced warning sign is to provide a self-contained, automatic, operation at the roadside without any dependency on back-office command and control systems to deliver the safety outcomes for which these devices are used.

For the purposes of this specification an Active Warning Sign is a fixed aspect active electronic display device. The displayed aspect is configured to warn an approaching vehicle of a hazard, using either a graphical or text-based aspect, or a combination of both, with the aspect specified at the time of manufacture. The aspect is presented to a user when a defined parameter related to the hazard is exceeded, such as approach speed, or by means of a pre-defined schedule. By definition the sign will require a trigger, typically this is expected to be integrated into the sign but must also make provision for external triggers to support specialist applications.

AWS are directly related to the identified hazard and are not intended for general purpose or messaging signals. Examples include curve warning, cycle warning and kura school speed limit signs.
Speed indicator devices (SIDs) are a little different in that they are intended to provide feedback to the driver on their speed and may not be directly linked to a potential hazard on the carriageway. They are included in this delivery specification as the technical requirements are very similar.

3.2.2 Waka Kotahi ITS class

001 Signs. Equipment which provides visual messages or warnings to users of the transport network.
Class definitions

3.3 Scope

This delivery specification provides requirements for all AWS types. Commonly used AWS include:

i. speed indicator devices (SID)
ii. curve warning signs
iii. cycle warning signs
iv. kura/school zones – active warning
v. variable speed limit signs – used in intersection speed zones (ISZ), weather-activated variable speed limit (WAVSL) zones and kura school variable speed limit signs
vi. slippery surface warning signs
vii. truck warning signs
viii. livestock warning signs
ix. Pedestrian warning signs
x. Equestrian warning signs

This list is representative but not exhaustive. Designers need to consult the TCD Rule for a comprehensive list of approved aspects. Any new signs, or a different layout of a sign illustrated in this delivery specification, must have their word/font/symbol/light-emitting diode (LED) layouts approved by gazette notice or the TCD Rule. In the first instance, contact tcd@nzta.govt.nz.

These AWS are denoted as R1-2.1 “Variable speed” (TCD Rule - Regulatory signs), or W19-2.1 “Symbolic warning – active LED” (TCD Rule - W19 General and symbolic signs).

3.4 Outcomes

3.4.1 Operational

By developing this delivery specification, Waka Kotahi is to achieve the following strategic outcomes specifically to ensure and enhance the Waka Kotahi dynamic hazard warning capability, including but not limited to:

i. providing a safer environment for road workers, drivers, road users using other modes of transport, and pedestrians
ii. increase road user acceptance of the information by improving the quality, operation and standardisation of information and images on all AWS types
iii. Define the ability for all AWS to be remotely monitored, operated and updated by improving asset monitoring capabilities
iv. Improve safety by providing hazard warnings to road users in advance of hazards and with enough time for a user to respond
v. improving whole-of-life ITS-related costs by supplying quality AWS assets, including reducing the Waka Kotahi environmental footprint
vi. improve utility of asset by capturing traffic data for analysis and compliance activities by developing a standard system to capture and report data.

This delivery specification for AWS contributes to the Waka Kotahi strategic fit, operational services, safety, efficiency and value for money.

3.4.2 For users of the transport network

AWS are intended to provide advance warning to the road user when approaching hazards on or adjacent to the roadway, ensuring easy identification of the hazard by means of appropriate aspect and any corrective actions the user needs to take. The desired outcome is to give users a clear, intuitive advanced warning of upcoming hazards or speed changes to improve the safety of all road users, including cyclists and pedestrians.

3.4.3 For road controlling authorities

AWS are tools that enable RCAs to warn of hazards on or adjacent to the roadway to meet safety outcomes. AWS will also provide data to enable the RCA assess effectiveness of treatment for future measures.
This specification will improve the solutions available to RCAs to manage safety outcomes and improved alignment with best practice and regulations of solutions.

4 FUNCTIONAL REQUIREMENTS

This section outlines what the equipment and systems need to do (functional), and how they need to do it (non-functional).

4.1 Sign aspect activation

All AWS must incorporate a trigger mechanism to activate the aspect when a defined parameter is exceeded or at a pre-defined scheduled time. The trigger mechanism may be integrated internal (radar, schedule etc.) or external (loops, cameras etc.).

All signs will also have the ability to be activated by the communications device to support remote user access and activation.

4.1.1 Radar

All AWS where the radar is used as the primary activation mechanism will have the ability to mount a radar internally which will activate the aspect of the sign based on vehicle approach and / or speed.

The radar shall be activated by approaching vehicles only, with individual vehicle tracking capability and vehicle by vehicle statistics.

The radar shall have the ability to operate in all weather conditions.

The radar upper and lower activation thresholds shall be able to be configured via dials or switches inside enclosure.

The radar shall have the ability to be adjustable, either electronically or physically to meet operating environment and to ensure sign aspect is triggered at the required distance.

Once a vehicle enters the radar field, the radar must be consistently capable of registering the speed of the vehicle and updating the display to meet operational requirements of the AWS solution.

4.1.1.1 Radar Accuracy

Real world applications of AWS can be in complex environments which may affect radar accuracy. Additionally testing in the field is difficult to achieve. Suppliers will be required to declare radar accuracy at time of procurement. Refer to section 6.6.

Ideally, we require a speed accuracy of ± 1km/hr and a count accuracy of minimum 90% in the real-world environment.

4.1.1.2 Radar operation – display refresh rate

Radar must refresh the displayed speed no more than once per second.

4.1.2 Other external triggers

Where not activated by the internal radar, all AWS aspects will have the ability to be activated by a variety of other external triggers.

Regardless of trigger mechanism, the AWS will activate as a minimum via a closed to ground switch.

Typical examples will be loops and cameras, however some signs such as cycle and stock signs will require a button and a timer activated by a traffic signal button.

4.2 Operation

A key function of each AWS is the ability for remote communication for scheduled configuration uploads, data downloads, status transmission and performance monitoring. All AWS must have the ability to connect to and communicate via a communications device located within the cabinet enclosure.

The AWS vendor must provide a full command/response specification of the AWS interface so that the agency retains control over the selection of a communications device and service.

AWS should be designed in such a way that they can interact with multiple different communication devices. The signs must be agnostic of device type.

All communication devices must comply with Waka Kotahi cyber security requirements.

4.2.1 Sign Control

4.2.1.1 Supervisory Control System

Requirements are detailed in Appendix B – Supervisory Control System.

4.3 Status reporting

Waka Kotahi intends to implement a system which allows control, performance monitoring and data extraction for each AWS. Each AWS must be able to communicate its internal state to a communications device when queried. Refer section Appendix B – Supervisory Control System.

4.3.1 Fault reporting

Sign controllers must be able to monitor their status for a set of pre-defined faults. AWS will be polled periodically by the Waka Kotahi asset monitoring system and any faults will be communicated back to the monitoring system.

Polling times may be varied depending on sign type and criticality so the AWS must be able to internally log faults and report when polled.

4.3.1.1 Fault error types

The sign controller must be able to detect, log and report when queried the following errors as a minimum:

Fault category	Activation	Sign response
Pixel error	On 10% failure on single LED board	Sign will remain operational Error logged
Power error	When power supply faults – batteries not charging or when mains supply fails	Error logged
Battery errors	Refer section 4.6	Error reported and logged
Temperature error	When internal temperature exceeds the maximum threshold set by the supplier	Sign will turn off –logged
Photocell error	When photocell fails and is no longer regulating LED brightness	Error logged
Communication error	On failure of communication internal to the sign	Error logged
Communication failure	On failure of communication between sign and operating system	Sign will operate on normal stored calendar and protocol
Door alarm	On opening of the enclosure	Error logged
Zero radar or digital input error	On zero activations over a 24-hr period (time modifiable)	Error logged

Table 1. Fault reporting error types

4.3.2 Data logging, transmission and retrieval

All events must be logged, timestamped, and retained locally. AWS should make logs available for query via the communications device.

Data will be periodically downloaded from the AWS by the operating system. Data download frequency times will either be on a regular predefined cycle or on request to the AWS out of cycle. Data should also be able to be collected by technician when on-site.

4.3.2.1 Sign Operation

All AWS must:

i. log all date and times of aspect operation regardless of activation method
ii. hold a minimum of two years of aspect event activations without overwrite in internal memory

When polled for operational data AWS will output a log of operation activation via Excel CSV file with year, month, day, hour, minute and second of activation.

4.3.2.2 Faults

All AWS must:

i. log fault type, date and time on immediate recognition of the fault
ii. log length of time of each fault occurrence
iii. hold a minimum of two years of fault events without overwrite in internal memory

When polled for faults data AWS will output a log of all faults defined by type via Excel CSV file with year, month, day, hour, minute and second of fault occurrence. Table will include length of fault and whether resolved or open.

4.3.2.3 Radar

Where radars are installed, all AWS must:

i. log vehicle speed on initial radar activation per vehicle with date and time
ii. hold a minimum of one year of radar events without overwrite in internal memory

When polled for radar data AWS will output a log of all radar activations via Excel CSV file with year, month, day, hour, minute and second of fault occurrence. Table will include initial speed on activation to the nearest Km/hr and final speed per vehicle to the nearest km/hr.

4.3.3 Power supply monitoring

Sign controllers must also be able to monitor a variety of battery parameters and errors. This information is to be cached in the internal memory for periodic reporting via the communications device. If the sign is mains powered with a battery backup, then battery discharge or operation is to be logged as well.

It is not expected that all battery diagnostic data will be regularly communicated to the operating system. However, it should be available on polling the sign or as a remote login to the sign.

4.3.3.1 Battery error types

The sign controllers must be able to log the following faults / conditions which will be available at each sign polling:

i. batteries are at a minimum of 10% life remaining or at low-voltage cut-off
ii. battery temperature is 10 degrees less than the manufacturer's cut-off point
iii. battery temperature reaches the cut-off point.

All parameters will be modifiable.

4.3.3.2 Normal operational Logging

At a minimum all AWS must log and report the following:

i. battery voltage
ii. % battery charge remaining
iii. where the AWS are solar powered controller must also log charging voltage.
iv. battery temperature

4.3.4 Internal environmental monitoring

At a minimum all AWS will have the ability to log internal temperature and humidity.

When polled for environmental data, AWS will output data log via Excel CSV file with year, month, day, hour and minute.

4.4 Date and time control

All AWS to have a self-contained internal clock the to maintain an accurate time and date while offline. Internal clocks will be able to adjust timing errors when online by syncing with an online reference clock to the nearest second.

4.4.1.1 Format

Time format for each logged CSV file will be in yyyy-MM-dd HH:mm:ss

4.4.1.2 Accuracy

Internal clocks will have less than 1 second deviation if offline for more than 1 month.

4.4.1.3 Syncing

Internal clock will be set to sync with an online clock at each polling of the AWS.

4.5 Visual display matrix

4.5.1 Display uniformity

The AWS must present a uniform and consistent aspect across the display matrix when activated for both luminous intensity (brightness) and colour.

4.5.2 Visible flicker

AWS will have no visible flicker to the normal human eye at any light intensity/level. AWS must also be machine readable, e.g., by sign recognition systems (including in-vehicle systems).

4.5.2.1 Frequency

In accordance with EN 12966 - section 4, product characteristics, AWS must meet a frequency of 100Hz or greater.

4.5.3 Display intensity and contrast ratio

AWS shall be able to measure the ambient external light conditions and automatically adjust the intensity of the sign display. For the purposes of this specification this will be referred to as a dimming system.
The dimming system shall ensure that the intensity of the sign display is unaffected by short fluctuations in ambient light conditions and vehicle headlights.

The dimming system shall ensure that the luminance output of the sign is maintained in accordance with the ambient and background light conditions, including direct sunlight and darkness.

4.5.3.1 Light sensors

The dimming system shall:

i. be able to adjust the intensity of the display to a minimum of 10 different levels
ii. take average readings over a suitable and configurable (60s ± 30s) period of time to modify the display intensity
iii. have a minimum of two light sensors per sign, one forwards facing and one backwards facing.

5 PERFORMANCE REQUIREMENTS

This section outlines the reliability and availability requirements of equipment, which may require independent certification and/or declarations of conformity.

5.1 Resistance to the effects of external conditions

The operating environment of AWS can be harsh. Equipment that is deemed fit for purpose is expected to continue to operate effectively exposed to the New Zealand environment as per the National Institute of Water and Atmospheric Research (NIWA), for a minimum of 15 years. It is essential that materials and manufacturing processes take this into account.

AWS shall be capable of continuous, normal operation (24/7 day and night) and maintaining performance criteria in the conditions described below:

i. installed and operated in direct sunlight
ii. ambient temperature range between –25ºC and +55ºC (class T2 as per EN 12966)
iii. enclosure air temperature between –10ºC and +75ºC
iv. maximum wind conditions likely to occur at the installation site as per AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions (AS/NZS 1170)
v. solar radiation with a value of up to 2000W/m^2 at direct sunlight, incident at an angle of 30 degrees from the vertical
vi. humidity between 10% and 95% non-condensing
vii. conditions, both permanent and temporary, that may be unique to the specified location, eg instances of thick smoke or electromagnetic interference
viii. marine environment
ix. road surface reflection.

AWS operation shall cause no adverse effect to the surrounding environment in which it is installed. Conversely, AWS shall not be affected by adverse environmental conditions expected at the intended installation location.

5.2 Enclosure finish

The finish of all AWS surfaces should not result in specular (mirror) reflection that distracts road users.

5.2.1 Cabinet surfaces

Cabinet surfaces (internal and external) must be powder-coated as per AS 4506-2005 Metal finishing – Thermoset powder coatings (AS 4506) for use in atmospheric classification D, which includes a minimum coating thickness of 60 microns over the pre-treated galvanised or aluminium sheet.

The colour of the display aspect is to be as per BS 4800:2011 Colour chart (matt black 00 E 53). Remainder of the cabinet to be aircraft grey.

External cabinet surfaces must have an approved anti-graffiti coating applied.

The enclosure surface must not:

i. reflect light back to the user to maintain contrast of the message being displayed
ii. use smooth, monolithic front screens (such as polycarbonate panels).

5.3 Mechanical

AWS shall be designed to ensure reliable transfer of all static and dynamic forces to the fixing and mounting structures.

AWS must meet class TBD6 as per EN 12966 for temporary bending deflection. See EN 12966 section titled Mechanical performance requirements.

5.3.1 Resistance of electrical/electronic components to the effects of pollution

The manufacturer shall declare the degree of resistance in accordance with EN 12966 section titled Resistance of electrical/electronic components to the effects of pollution.

5.3.2 Resistance to surface corrosion

The surface protection of AWS enclosures against corrosion shall meet the requirements of EN 12966 section titled Resistance to corrosion of discontinuous VMS.

5.3.3 Enclosure: ingress protection against water and dust

AWS enclosures shall be protected against water and dust ingress in accordance with EN 60529. All AWS enclosures must meet a minimum IP rating of IP56.

5.3.4 Vibration resistance

The AWS shall be capable of withstanding vibration in accordance with table 19 of EN 12966 section titled Environmental and mechanical tests.

5.4 Visual performance

5.4.1 LED colour palette

When observing the whole AWS display matrix from all viewing angles within the specified beam width, colours shall not be discernible as individual red, green and blue light sources.

5.4.2 Beam width

The LED elements for AWS shall meet class B6 for EN 12966, ie, have a minimum of 30 degrees total beam width. Some applications will require a narrower beam width. These will be site specific and requested via project technical specifications as required.

5.4.3 Colour

All AWS must meet colour class C2 as per EN 12966. The chromaticity coordinates of the required colour parameters are defined in figure 1 of EN 12966 section titled Colour.

5.4.4 Luminance

All AWS must meet luminance levels to class L3 as per tables 4 to 9 of EN 12966 section titled Luminance.

5.4.5 Luminance ratio

All AWS must meet luminance ratio (LR) class R3 as per table 10 of EN 12966 section titled Luminance ratio.

5.4.6 Uniformity of luminous intensity

There are two requirements around luminous intensity for which each colour (as specified in section 5.4.3 Colour, above) must be tested as follows:

Luminous intensity		Ratio of output
Highest 12%	Lowest 12%	3:1
Highest 4%	Lowest 4%	5:1

Table 2. Uniformity of luminous intensity

5.4.7 Degradation of visual performance

AWS design solutions must consider the impact to visual performance (i.e., colour, luminance and LR) caused by ageing effects. The visual performance requirements are minimum requirements and must be achieved during the entire operational lifetime of the AWS (15 years).

5.5 Maintainability

AWS shall be designed:

i. so all the internal components can be easily and quickly replaced in the field
ii. to be installed and maintained by local technicians following the manufacturer's supplied documentation

iii. to be easily accessed for maintenance
iv. to minimise onsite cyclic maintenance

6 TECHNICAL REQUIREMENTS

This section outlines specific technical and physical constraints for the equipment.

6.1 Electrical safety

All ITS equipment must comply with and be installed in accordance with Electricity (Safety) Regulations 2010 (SR 2010/36) and AS/NZS 3000:2018 Electrical installations.

6.1.1 Equipment declaration of conformity

The vendor shall supply a declaration of conformity for the AWS in accordance with SR 2010/36, sections 80 (2) and 81.

6.1.2 Installation of electrical equipment

The installer is required to supply a certificate to confirm the equipment has been installed correctly and is compliant with AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules (AS/NZS 3000). The electrician/electrical engineer who installs the equipment must provide the required certification. This includes acceptance of the declaration of conformity.

6.2 Electrical

6.2.1 Power supply – mains (including streetlight)

The preferred power supply where available will be mains power. Mains power can consist of 24-hour continuous supply or from a discontinuous streetlight circuit. Power cable sizing should be undertaken by a qualified electrical engineer according to the maximum power consumption.
Supplier will provide a safe DC voltage to the AWS.

Variations in the nominal supply voltage of –13% to +10% shall not affect the sign functions.

Variations within the frequency range 50 +/– 1Hz shall have no effect on the operation of the sign.

Mains-powered sites will have a battery backup system for mains failures. The battery backup system will be able to operate the sign for normal operations for a minimum of 72 hours.

Mains-powered sites on streetlight circuits will have a battery backup system sufficient for full daytime operation as required.

6.2.2 Power supply – solar

AWS may also be powered by solar energy. Supplier must be able to supply suitable solar panels with the AWS when requested.

All batteries and solar charging regulator should fit within the sign enclosure.

Solar panels can be located on the same support structure as the sign.

6.2.3 Battery requirements

Batteries will be supplied with all AWS for backup on mains failure or normal daytime operation for discontinuous streetlight circuits and solar.

The battery backup system will be able to operate the sign for normal operations for a minimum of 72 hours.

Sign controllers will be able to interrogate and communicate battery status (voltage percentage) via the communication device.

The battery system will have a low-voltage cut-off to protect the battery.

6.2.4 Electrical surge protection

All equipment shall be internally protected against damage resulting from:

i. lightning strikes near AWS sites
ii. electrical transients on power cabling
iii. electrical transients on internal and external signal wiring
iv. electromagnetic interference
v. static electrical discharge.

6.3 Sign Controller

The controller must:

i. have the ability for firmware upgrade by a maintenance contractor or technician, either remotely or at site.
ii. Provide an interface to a communication device for the purposes of exchanging information, transmission of logs, alarms and configuration. Refer Appendix B.

Communication interface standard will be supplied by Waka Kotahi, please contact itsspec@nzta.govt.nz.

6.4 Physical characteristics

6.4.1 Front panels

AWS front panels should be designed in such a way that no part of the message displayed is obscured when observed from the required viewing positions.

6.4.2 Front screens

Front screens adversely impact the intensity of light being transmitted from the AWS and can be prone to degradation caused by weathering and exposure to intense direct sunlight. Consequently, monolithic screens such as polycarbonate panels or louvres are not permitted.

AWS which allow portions of the front screen to be removed (modular) may risk weather tightness of the enclosure and are not permitted.

6.4.3 Doors and maintenance access

All covers, doors, plates, glands, external connectors etc shall be provided with rubber seals or equivalent materials which are maintenance free and shall remain effective for the design life of the equipment.

Where access doors are provided, they shall all be fitted with a suitable retention stay or gas strut to hold the doors in the open position for the safety of maintenance personnel working inside the enclosure. They must include physical security against unauthorised access and have a door-open alarm capability to remotely report that any of the doors were opened.

For security, access doors and panels shall be fitted with suitable locks (one lock per door/panel), designed for outside conditions. Unless specified otherwise, all access door locks shall have an identical key and the supplier shall provide at least four copies of the key.

Maintenance access must be available without removing the sign from the post.

6.4.4 Cable entries

All power supply, control and communication cabling shall enter the AWS enclosure through appropriately constructed, sealed and glanded entry holes in the base of the sign.

6.4.5 Electrolytic compatibility

Components shall comprise of materials that when assembled into the AWS are electrolytically compatible and environmentally stable.

6.4.6 Mounting to support structure

Typically, signs are rear mounted on single, frangible poles. AWS shall have a minimum of two mounting channels fixed to the cabinet horizontally. Any penetrations into the enclosure shall have fully captive nuts so that the IP rating is not compromised.

Mounting channels shall be a standard New Zealand off-the-shelf product, suitable to take the weight of the sign.

Modifications to AWS enclosures are not permitted once they have left the place of manufacture. AWS enclosure mounting points must be agreed with the design engineer.

6.4.7 Venting, heating and cooling

Signs will have no mechanical heating or cooling elements. The signs should be able to operate in all New Zealand weather conditions and seasons, operating within the stated temperature class T2 (ambient temperature –25°C to +55°C) from EN 12966.

Signs will have no large venting apertures, however screw-in air vent valves are acceptable if required. These should be installed so as to not affect the IP rating of the enclosure.

6.4.8 Labelling

All LED modules, signal controller boards and other similar serviceable parts shall have unique serial numbers permanently marked, which cannot be removed and shall not ever be modified.

6.5 Display matrix

6.5.1 Physical layout

Front display face will be of a punched hole type. Monolithic polycarbonate sheets will not be allowed. Signs can be full front face matrix, incorporating the images roundels and text or a full matrix used for the numeral text only.

Where the AWS is required to display numerals, such as ISZ AWS or School/Kura Variable speed limit signs, the portion of the display used for the numerals must be formed using a regular matrix, i.e., the spacing between pixels in both the x and y axes is uniform.

Matrix will be of sufficient size in order to display correct font shape and height for each AWS type requirement.

6.5.2 Display technology options

LED technologies are the default choice for the active portion of the displays for all AWS applications. This technology provides good visibility under most viewing conditions, high reliability and low optical degradation, and has low maintenance requirements.

6.5.3 Pixel pitch

The maximum pixel pitch for all applications will be 16mm. Where the signs display an image, the LED infill pattern must facilitate the display of smooth graphics which closely resemble the image required.

From the minimum reading distance (60m in urban areas) any image and red roundel should appear to be a continuously filled area rather than discrete points of light. It is critical that the luminance and luminous intensity values specified are met or exceeded to meet these requirements.

If the sign is required to display a pulsing roundel, the roundel will be comprised of three concentric rings of LEDs which, when all on, have an effective thickness of 90mm. As per TCD Rule – the outer ring must be continuously illuminated while the other rings may flash or pulse with a frequency of 1 Hz.

6.5.4 LEDs

AWS suppliers are required to provide evidence that LEDs supplied as part of any AWS meet the quality, luminous intensity ratings, batch requirements and life expectancy (refer to section 5.4.6 Design life).

Details of the current rating of the proposed LEDs to be used, and what actual current they will be driven at to meet the luminous intensity requirements, must be provided.

LEDs must be sourced from the same batch/bin in order to mitigate the risk of minor variations in colour output.

The latest high-quality manufacturing techniques must be used to ensure that:

i. exposure of components to mechanical or thermal stress is minimised
ii. manual handling of sensitive componentry is minimised
iii. conformal coatings are consistently applied to circuit boards to minimise exposure to condensation.

Whilst there is no standard size prescribed for the modules forming the display, they should be of a size that is easy to replace with the AWS in situ in the field and without the need to dismantle any part of the AWS. Pixels and/or pixel mounting blocks shall be modular and easy to swap/replace without requiring any soldering or any other form of heat-based bonding to other electrical components as part of the process.

6.5.5 Display legend

All AWS shall be display fonts and symbols that match the requirement of the current TCD Rule. This includes the font, symbols, sign layout, colours, beacons and operation. Refer to Appendix A: specific requirements.

6.5.6 Beacons

Some signs are required to have beacons as described in the TCD Rule. LEDs for the beacons will be arranged in a circular pattern with infill pattern of LEDs at 16mm pitch maximum.

Beacons are to flash when the sign is activated as described in the TCD Rule at a frequency of 1Hz (0.5 second display).

6.5.7 Rear indicator

All signs and all variable speed limit signs shall have a 50mm diameter orange light on the rear of the cabinet which is activated when the sign is on. The light shall:

i. consist of a circular pattern of LEDs with an infill pattern at 16mm pitch maximum
ii. be readily visible in bright sunlight to 300m
iii. be shrouded to avoid light spill.

6.6 Documentation, software and licensing

6.6.1 Documentation

AWS vendors must supply original equipment manufacturer (OEM) maintenance, service and operations guidelines and manuals which will include maintenance schedules and procedures, handling and storage, and spares list.

Vendors must also supply product sheets for additional equipment within the AWS such as radars.

6.6.2 Software and licensing

AWS vendors must supply all software and licensing required to configure and manage the AWS to Waka Kotahi or its agent's use. Any software applications or tools required to manage the AWS will be supplied with the asset when procured. Tools and software such as those required configure the AWS operational requirements, interrogate faults and logs, manipulate raw data and update firmware.

6.6.3 Certification and declarations of conformity

All AWS supplied to Waka Kotahi must include a declaration of conformity from the manufacturer to meet the performance requirements of this specification. Suppliers must be able to supply factory quality control documentation on request, including but not limited to powder coating, LEDs, radars, IP rating and testing certification.

Independent certification of all performance parameters will be undertaken or supplied on request at time of procurement.

6.6.4 Testing and commissioning

Further requirements including, but not limited to, factory acceptance testing (FAT), site acceptance testing (SAT), spare parts inventory, service manuals, warranty, defects liability period and terms of payment must be specified by Waka Kotahi in the procurement of AWS but are outside the scope of this delivery specification.

7 APPENDIX A: SPECIFIC REQUIREMENTS

7.1 Variable speed limit (R1-2.1)

These signs are described in the TCD Rule. All signs shall meet the requirements of option B, i.e. flashing roundel with no flashing lights in the corners.

The roundel must consist of three rings of LEDs. When activated, the outer ring must be continuously lit, but the inner rings shall flash at 1Hz cycle (0.5 second display).

Figure 1. Example shown with flashing roundel

Signs must be able to be configured internally to display any speed limit. A physical switch or dial will be required to simply modify the displayed speed.

7.2 Speed indicator devices

SIDs measure a vehicle's speed and display the recorded speed to the approaching motorist. Signs are non-regulatory but are installed at changes in speed thresholds. These signs are not covered by the TCD rule.

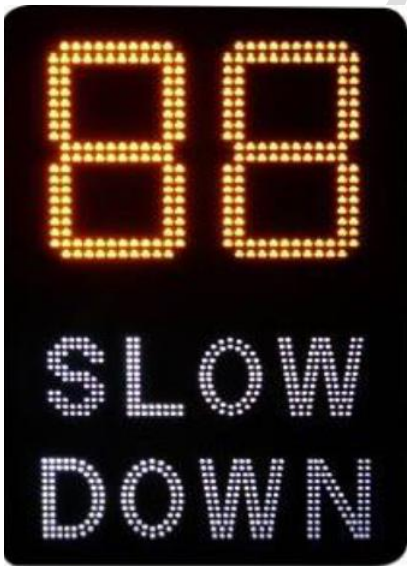

Figure 2. Example speed indicator device

Category	Dimension (mm)
Display dimensions (rectangle)	700 wide x 1000 high
Numeral height	400 minimum (fixed 88 pattern acceptable)
Numeral colour	Amber LED
Font height (SLOW DOWN)	160 minimum
Font colour (SLOW DOWN)	White LED
Pixel pitch (all LEDs)	16 maximum

Table 3. Display parameters speed indicator device

7.3 Other AWS

All aspects of other AWS types (including font, legend, dimensions, colours and operations) must comply with the TCD Rule (https://www.nzta.govt.nz/resources/rules/traffic-control-devices-index/).

8 APPENDIX B: SUPERVISORY CONTROL SYSTEMS

8.1 Purpose

The supervisory control and communications controller is designed to supplement control, monitoring, and configuration functions of simple standalone autonomous field devices, such as Active Warning Signs. Further This class of device typically has no communication requirement to deliver operational outcomes. This application will provide an out of band ultra-light and retrofittable solution to overcome this and provide improved monitoring of the asset's status, and collection of traffic data from on board detection devices, such as radar, installed in the AWS.

Provision of the supervisor will also provide the opportunity to enhance the current monitoring capability, for example addition of accelerometers would provide the ability to detect if the asset has been knocked over.

8.2 Base requirements

To facilitate the ability to retrofit a supervisory controller the following is required to be provisioned from the asset, in this case Active Warning Signs.

i. The sign must expose a supervisory control and monitoring interface that permits access to all sign control commands as well as interrogation of sign internal state or registers for the purpose of collecting environmental data (eg temperature), telemetry (eg battery voltage), warnings and faults.

ii. The electrical interface shall be RS232 or RS485 and support at least one (or more) of the interfaces, with the following serial settings (Typical default settings boldened):
   - ELECTRICAL: **RS232**, **RS485**
   - BAUD RATE: **1200**, 2400, 4800, **9600**, 19200,34800,115200
   - PARITY: **None**, Even, Odd
   - STOP BITS: 0.5, **1**, 1.5, **2**

iii. In the case of RS232 the hardware shall only use TX, RX and GND. There shall be no hardware or software flow control methodology.

iv. The serial interface control and data exchange method must be documented and provided to NZTA for the purposes of interfacing to the supervisor this includes:
   - Packet framing methodology for data exchange. How packets are framed over the communication protocol is up to the vendor, though it is recommended to use an industry standard framing methodology such as Modbus RTU.
   - The packet framing methodology shall include a message integrity / error-checking sequence (eg. CRC)
   - Command parameters and responses codes, including any timing diagrams for half-duplex communications.

v. The communication protocol shall be stateless. Eg. each command is atomic and fully self-contained. No command/control sequence has any dependency on any prior commands being issued.

vi. The sign shall act as a server/slave in all aspects of interactions via the supervisory communication port.

vii. The sign shall not transmit any unsolicited messages via the communication interface once booted and stable. (eg. It only responds to commands/queries. It does not publish a “startup” message when powered on).

viii. The physical termination of the communication interface shall be:
- In the case of RS232, a female DB9 connector or screw terminals
- In the case of RS485, a female RJ45 port (vendor to specify pinout) or screw terminals

ix. The communications port shall be easily accessible when the sign is fully installed including supporting equipment such as batteries.

x. The sign shall expose a screw-terminal interface to allow the supervisory control system to be wired directly to the sign’s power supply system prior to any load output switching on battery charging systems.
- VOLTAGE: 9-24VDC
- MAX CURRENT: 2A
- BASE CURRENT: 150 mA

xi. In anticipation of mounting an antenna to support retrofitting of the supervisor on signs in the field, the sign vendor shall either:
- provide a pre-drilled and plugged 12mm diameter hole in a flat top surface (inside and out) with at least 40mm clearance radius
- or allow for a hole to be drilled in the top surface of the sign (without voiding any warranty)
- or fit a capped SMA bulkhead RF connector, with tail, to the top surface of the sign with male thread and normal polarity. The tail should be long enough to reach anywhere inside the sign, terminated with a female SMA with normal polarity. The RF cable shall have an impedance of 50 ohms.

9 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

9.1 Industry standards

Standard number / name	Source	Licence type and conditions
AS 4506-2005 Metal finishing – Thermoset powder coatings	Standards Australia website	Available for purchase
AS/NZS 1170.2:2011 Structural design actions – Part 2: Wind actions	Standards NZ website	Available for purchase
AS/NZS 3000:2018 Electrical installations – Known as the Australian/New Zealand Wiring Rules	Standards NZ website	Available for purchase
BS 4800:2011 Colour chart (matt black 00 E 53)	e-paint.co.uk website	Publicly available
EN 12966:2014+A1:2018 Road vertical signs. Variable message traffic signs	Standards NZ website	Available for purchase
EN 60529:1992+A2:2013	Standards NZ website	Available for purchase
SR 2010/36 Electricity (Safety) Regulations 2010	NZ Legislation website	Publicly available
Conformal coatings standard - TBC		
RS-485 (ANSI/TIA/EIA-485-A-1998)	Telecommunications Industry Association website	Available for purchase
RS-232 (ANSI EIA/TIA-232 1997)	Telecommunications Industry Association website	Available for purchase

9.2 Waka Kotahi standards, specifications and resources

9.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements listed below.

Document name
ITS delivery specification: Active warning and regulatory signs

9.2.2 Resources

Document name / code	Waka Kotahi website link
Land Transport Rule: Traffic Control Devices 2004 (TCD Rule)	https://www.nzta.govt.nz/resources/rules/traffic-control-devices-2004/
Traffic control devices manual (TCD manual)	https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

9.3 ITS standard drawings

See the Waka Kotahi website for the latest versions of the ITS standard drawings listed below.

Drawing number

10 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class
5.1	Resistance to the effects of external conditions	Environmental core requirements standard	000 Core requirements
5.3	Mechanical	Environmental core requirements standard	000 Core requirements
6.1.2	Installation of electrical equipment	Electrical core requirements standard	000 Core requirements
6.2	Electrical	Electrical core requirements standard	000 Core requirements
6.3	Sign Controller	Communications Standard	000 Core requirements
Error! Reference source not found.	Cable entries	Electrical core requirements standard	000 Core requirements
Error! Reference source not found.	Electrolytic compatibility	Environmental core requirements standard	000 Core requirements
Error! Reference source not found.	FAT, SAT, commissioning, spare parts, servicing manuals, warranty, defects liability period	Commissioning and handover core requirements standard	000 Core requirements
Appendix B	Supervisory Control Systems	Communications Standard	000 Core requirements

11 FULL VERSION HISTORY

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or, if it's a major update, 2.0 and so on.

Version	Date	Author	Role and organisation	Reason
0.1	10/06/2022	WSP	WSP	First draft
0.2	31/07/2022	Final Word	Editorial services	Proofread first draft
0.3	09/09/2022	WSP	WSP	Second Draft
0.4	14/09/2022	WSP	WSP	Third Draft
0.5	10/11/2022	WSP	WSP	4th Draft
0.5	20/12/2022	WSP	WSP	5th Draft